

**Impact of Atomic Energy on Our
Economy
and Way of Life**

by T. Keith Glennan

To follow two such distinguished gentlemen of science and public affairs in any discussion of the atom is a tough assignment. Their continued association with the nation's atomic energy program in its more beneficent aspects and with the scientists who are pushing forward the frontiers of nuclear knowledge lends an aura of authenticity to their statements that will be hard to discern in my paper.

And yet it is no less necessary that we examine into the probable impact of this great new source of energy on our economy and way of life than that we discuss the experimental evidence of advances made possible in the treatment of disease by the use of radioactive materials; or that we discuss the impact of increasing amounts of knowledge of the behavior of sub-atomic particles upon the various fields of science and technology. For ultimately, the measure of the progress we presume we are making must involve the cumulative effect of all facets of the use of nuclear energy upon our lives.

The topic assigned to me is a formidable one indeed. Perhaps by reducing the problem to bare fundamentals, however, we can examine its various parts briefly and then develop a rational and useful picture of the probable effects of increasing use of nuclear energy on our social and economic organization. In discussing this as a method of approach with a colleague a few days ago I was the recipient of this sage advice - "If Einstein could reduce the fundamental relationships of energy and matter to the simple formula - E equals MC^2 , there is hope that you can cover, in a matter of thirty minutes and in broad outline only, the impact of atomic energy on our economy and way of life."

Thus challenged - and with the help of my crystal ball and, hopefully, some measure of common sense - it seemed to me that I might best serve your interests by discussing the peaceful atom in terms of present industrial activity, in terms of present governmental activity, and in terms of the important problems that may impede progress toward the ultimate goal of useful and widespread exploitation of the nuclear field. Finally, with your indulgence, I'll look ahead a bit and try to suggest the possible course of events for the future.

If we are going to look at the economy as it may be affected by industrial and governmental interest in the atom we can most easily approach the subject by speaking in terms of "bulls" and "bears." The economy either expands or it contracts. Business tends to boom or to bust. There is either prosperity or depression or as we have come to view it in these latter days - recession. Seldom does one find the economy static. Perhaps its most dominant characteristic is that - as J. P. Morgan once said of the stock market - "it will fluctuate." Our national policies tend toward optimism. We are committed to an expanding economy - as a matter of fact, both of our great political parties are committed to the maintenance of the economy in a healthy state. Neither would hesitate to use the vast powers of the government to bolster the economy through expansion of credit, expenditures for public works and the whole gamut of fiscal and legislative devices which have been found to be effective in the recent past.

Where does the industrial atom fit into this picture? So far as one can see it is on the bullish side - some would say strongly so. Measured against the situation existing two years ago when the activity was essentially zero even a conservative minded person would have to say that there is optimism in the air. Caution, born of ignorance growing out of a tight security program, is being swept aside by aggressive non-competitive risk-taking born of the 1954 change in the Atomic Energy Law and of optimism supported by faith in the ability of the engineer to solve the technological problems which remain as the principal obstacles to economically competitive power generation.

The evidences of this bullish tendency on the part of industry are becoming impressive. This audience is made up of people of affairs who must keep abreast of important developments in the industrial and political world. There is no necessity here for me to do more than list the more important actions taken by industry to further competitive non-governmental involvement in the burgeoning atomic energy business. Such a list would include the announcement of the building of a 236,000 kw 55 million dollar atomic power plant by Consolidated Edison of New York without governmental funds and with Babcock and Wilcox as the prime contractors; the submission to the AEC of proposals for the building of atomic power plants by four utility groups - three privately owned and one public power district - with governmental participation estimated to amount to less than 20% of the total cost and restricted to the research and development phases of the projects;

the privately financed \$6.5 million materials testing reactor to be built by Westinghouse; American Machine and Foundry's \$1.5 million research reactor; plant additions by Babcock and Wilcox and Combustion Engineering for the sole purpose of building reactor components and equipment; and Standard Oil Development's construction of a laboratory for research in nuclear science. North Carolina State, Penn State, the University of Michigan, Batelle and Armour Institutes and your own great M.I.T. are building or will build reactors using funds provided by industry and individuals. Perhaps one of the most interesting instances of enterprise is that of the offer made by both Foster-Wheeler and by Babcock and Wilcox to design and build large scale nuclear power plants at a guaranteed cost per kilowatt that exhibits substantial faith in the future of the reactor business.

Now, one of the really significant facts to be kept in mind is that the power proposals made to date are based on as many different reactor concepts as there are proposals. And yet each is backed largely, indeed, in most instances, wholly - by private capital. Since none of these units is believed to be economically competitive with the average conventional thermal power plants, it is apparent that competitive industry is using risk capital to speed the technological improvements necessary to the rapid development of a truly competitive nuclear power industry. Could there be a more solid example of optimism and bullish activity?

But there is additional evidence of confidence being displayed by the American business community. The Atomic Industrial Forum is an organization of about 300 industrial concerns and research institutions. It is devoted to fostering the development of atomic energy for peaceful purposes. In April of 1954, the Forum with the cooperation of the Atomic Energy Commission, undertook to survey the plans of American industry in the atomic energy field over the course of the next ten years. Some 400 companies representing about 75% of the dollar volume of the present atomic energy industry were surveyed. Here is a brief of the significant findings of the survey:

- 1) Industrial organizations and privately financed institutions in the U. S. plan to spend \$300 million of their own money during the next four years in atomic energy research and development including capital facilities.

2) By 1963 the manufacture of components will probably be a business grossing over \$700 million per year.

3) By 1965, it is estimated that between 3 and 7.5 billion dollars will have been invested in the U.S. in reactor construction. That is a wide spread to be sure, but even the lower estimate represents a substantial plant investment. About half of this volume would be represented by propulsion reactors.

4) By 1965 reactor operation may call for an annual consumption of 8,000 metric tons of natural uranium and a possible total of 26 tons of U-235.

5) Also by 1965 atomic energy developments, both government and private will call for a total of 30,000 to 40,000 scientists and engineers, or about double the number in both categories today.

6) Large reactor power plants will become economically competitive between 1962 and 1965.

On May 23rd and 24th the Forum held a members meeting in New York to discuss the meaning of these findings. Typical comments heard in the halls and reported in the Wall Street Journal included this one by Carroll Wilson, Vice President of Metals and Controls Corporation of Attleboro, Massachusetts - "there will be large risks and commitments, but the stakes are big." And by R. C. Freeman of General Electric - "we're in this business for the long pull." And by Leonard Croakite, President of Atomic Instruments Company as he said - "you've got to stay at the head of the parade, constantly developing new products and seeking new markets." No sign of pessimism here, is there?

The government, too, is not without an attitude of bullheadedness toward the future of peaceful use of the atom. It was this confidence, prodded somewhat by industry and the Congress, that was the major reason for the \$200 million dollar five-year reactor development program launched by the Atomic Energy Commission last year. The purpose of this program is to push

five different types of power producing reactors through the successive phases of research, development and successful operation. You will recall the program I am sure when I tabulate the five units as:

- 1) the pressurized water 60,000 k w plant being built by Westinghouse for Duquesne Light near Pittsburgh;
- 2) The sodium graphite pilot plant being developed by North American Aviation in California;
- 3) The boiling water reactor being developed by the Argonne National Laboratory;
- 4) The fast breeder reactor again being developed by Argonne;
- and
- 5) The aqueous homogeneous reactor being developed by the Oak Ridge National Laboratory.

Add to this the submarine and large ship propulsion units, the aircraft propulsion program, and the package power units for the Army and you have a substantial undergirding of the industrial program by continued governmental research and development and prototype construction of a variety of types of power reactors. And the government is committed to a continuation of this support although it will diminish with time.

At this point let me say that, personally, I take great satisfaction in the present state of affairs. During and immediately following my term as a member of the AEC, I urged upon industry an aggressive interest in atomic energy. Money talks - usually - and the expenditure of money by the early study teams and impressive technological progress within the Commission laboratories combined with other and important factors to convince the Congress and the Commission that the time had come for a new look at the basic atomic energy law. It was not always this way! As recently as the spring of 1952, I can remember a member of the House Appropriations Committee demanding that he be assured that the AEC's budget contained no money for industrial atomic developments! Now the atmosphere has changed in three short years!

All this activity is obviously based on an optimistic view of the future of atomic energy. The optimism is strong and widespread. Even the government, which is not usually inclined to prognosticate, has talked in terms of from two to ten percent of the total electrical output in the U. S. being produced from atomic energy by the year 1975. This could mean as much as 40 million k w of installed capacity - an amount equal to 40 percent of the total installed capacity in this country in 1954.

It is almost fair to say that it is fashionable today to be optimistic. As a matter of fact, much of our foreign policy today is based on the optimistic assumption that the atom is really going to amount to something. For example: there is the entire atoms-for-peace program, with its Geneva Conference, its atomic-powered peace ship, its bilateral agreements with our friends overseas, and its plans to set up an International Atomic Energy Agency.

Today's optimism is reflected in the stock market, where the shares of companies with publicized atomic energy activities sometimes jump as much as 15 points and more in 48 hours on the basis of announcements and even rumors of mergers, contracts and plans.

In the light of all this, it would be easy to stand here today and say atomic energy will have an enormous impact on our economy and way of life. One could speak of economic power, of package power plants changing the face of the land and the lives of people in remote regions of the world, of a new chemical industry built on the use of radiation, of a new food industry built on radiation sterilization techniques, and of a myriad other beneficial applications ranging from the mastery by man of the photosynthetic process to the elimination of disease.

The problem, however, is to find where in this welter of dreams reality lies. Is the current optimism just a passing fad, founded on hopes and nurtured on publicity, or is it something more substantial? Is it based on a realistic and hard-headed evaluation of the known technological and economic probabilities.

Before going on, I think I should make clear my own position. I think it would be fair to say that in regard to atomic energy I am a bull. But I am what I like to think of as a realistic bull, or a bull whose optimism is tempered by a real respect for the enormous problems ahead. Another way of putting it would be to say that I believe more in what I would call the atomic evolution than I do in the atomic revolution.

So in the hope that I have made clear my own sincere belief in the future of atomic energy, let me - to keep the record straight - list just some of the obstacles that must be overcome by hard work and much imagination before we can honestly hope to arrive in the promised land.

Let's begin with uranium - the raw ore.

Here is one place where the optimists of the past have already been proved right. There is more commercial grade uranium known to exist today than almost anyone believed possible ten years ago. In passing, let me pay tribute to Jesse Johnson, Director of Raw Materials of the AEC and to Commissioner Thomas E. Murray whose optimism and stubborn pursuit of increased supplies of uranium must be acknowledged as one of the major contributions to the health of our great atomic program today. The uranium mining industry in the U. S. virtually non-existent following the war, is now a \$100 million a year industry. It is of the same order of magnitude in Canada. Enormous quantities of uranium are now being extracted commercially from gold residues in South Africa. The rich Shinkeloewe mine in the Belgian Congo continues to produce. Important deposits are being found in Australia and elsewhere. And the bulk of these ores are being purchased by the United States.

But much of the exploration that led to these discoveries, and nearly all of the major production of the world, can be attributed not to any normal, peaceful, civilian industry, but to the fact that there has been an almost insatiable weapons market for uranium. Prices have been guaranteed, liberal bonuses and allowances have been paid.

The guaranteed minimum price in the United States expires in 1962. One problem ahead is what happens after 1962. Even the optimists have questioned whether the civilian industry will be able to absorb uranium at the present rate of world production until after 1980. Should the government continue its guaranteed prices? Really, there should be only one reason for doing this and that is the weapons program. But who can say for sure what the weapons market will require? Even if the military services thought they knew today what they would need in 1962 and beyond, how can they be sure in a situation fraught with such unknowns as the results of international political maneuvers, technological bottlenecks and breakthroughs, and the opinions of yet-to-be-appointed-or-elected officials? And the mining industry will need to know what governmental policies on ore procurement are to be - long before 1962. This is indeed a difficult problem that can be resolved only within the AEC.

The real problem here is the development of a price guarantee and buying schedule to be effective after 1962 that will tide the uranium mining industry over until the power and propulsion demand can replace the military demand that has formed the basis of the industry in the past. There are other problems among them ore processing, feed materials processing, fuel fabrication, materials development, fuel reprocessing and waste disposal. Listed to Glenn Seaborg speaking at the Forum Stanford Research Institute meeting in April in San Francisco: "In my opinion a limit to the extent to which atomic power can be used in the future will be set by the ultimate solution to the waste disposal problem, and here, it seems to me, the path for the ideal solution must lie outside of any ideas presently contemplated." These are the tough and, in some cases, nasty jobs that are just as important, in their own way, as the actual nuclear reaction itself so far as the economic production of heat power and radiation is concerned.

There are other problems too, not all technological. For example, there is the problem of insurance. The potential hazards of atomic energy are enormous. No one expects a reactor to have a catastrophic accident, but owners and operators want to be covered if it does. But no insurance company will write, as yet, the policies involved.

In summary, it seems clearly evident that determined attempts are being made to industrialize the atom within the framework and using the methods of our traditional competitive enterprise system. What I have done thus far in this discussion is to bring together elements of the atomic picture that should be known to all who will read. I have tried to paint a sort of unfinished picture with these elements - unfinished because of the problems that remain to be solved - unfinished because of the international political scene which continues to make the explosive potential of the fission and fusion process still the paramount objective of our national atomic energy program. There is no question but that we are embarked on an imaginative journey to new horizons but patience, diligence, courage and constructive planning will be needed in full measure if we are to achieve the great goals envisioned by President Eisenhower and our statesmen - goals of peaceful progress for all peoples through the gateways opened by the split atom.

In some ways I think I have strayed a bit from my topic. I have told you about the state of the economy as it relates to the development of an atomic energy industry. I have not ventured to say much about the impact of atomic energy on our total economy and our way of life. But I will try now, as I conclude, to suggest some thoughts

on the more philosophical aspects of this subject.

Our way of life once included an almost automatic response to threats of violence to the person or property of an American citizen. Today, because of the involvement of civilian populations in modern wars and because of the destructive powers of the atomic and hydrogen bombs, we try to find peaceful solutions to such problems. National tempers are less prone to flare at the slightest provocation than was once the case. In this I find no real danger of appeasement without honor. Rather I find hope that men may yet learn to solve their problems with out resorting to force. Until this becomes the rule, we must continue to speak with a firmness that is born of the knowledge that we seek justice and peace for all men and backed by the knowledge that if force be needed, we shall not be found wanting. The atom may well be acclaimed the instrument whereby wars are outlawed in the days to come. Fervently we should pray that this becomes a reality.

With respect to our internal economy, it seems clear that the exploitation of the peaceful atom will involve the development of new and significant relationships between government and industry. What these will be no one can say now. But "regulation" and "licensing" are becoming common place words in atomic energy jargon. It is important that the best interests of all the people be served in the industrialization of the atom - not the political ambitions of those who would use or misuse the glamor of the term for their own ends. In the development of this new relationship which deals with enormous amounts of energy - for good or evil - it is important that we make haste slowly.

Turning to the international scene and the usefulness of the atom as an instrument of foreign policy we find ourselves confronted with an interesting situation. One often hears the question asked - when will power generated through the use of nuclear fuels replace power generated through the use of conventional fuels? The question can be answered rather simply. For a long time to come power will be supplemental power. It will dominate the power field only when it is cheaper than conventional power generation and when the existing power plants are retired from service by reason of age or obsolescence. But in the question there seems to be some suggestion that when atomic power does replace conventional power something new and different will have a great effect on our lives. As a nation, we have utilized power to supplement and to replace the physical exertions of men. Power generated from nuclear fuels will do this just as well but no better than is the case with conventional fuels. Stripped of its glamour, nuclear power will extend our capacity to substitute mechanical energy for human energy. There can be no question but that nuclear fuel

assures the continuation of our type of mass production economy for generations and perhaps centuries to come. And more importantly, it should make available to power hungry areas of the world one of the most basic ingredients of a material prosperity.

But are there not other aspects of this matter that should engage our thoughtful attention? If we could export today completely packaged nuclear power plants, would not the availability of such plants to one of the world's backward and power hungry nations gain for us additional friends in the battle for man's minds? At first glance I am sure we would agree that here is a powerful tool for winning the peace. And so it is - but I wonder just how much of the industrial revolution's evolutionary aspects a nation may avoid. The availability of power in itself is not enough. Along with it must go other elements in a machine economy - raw materials, a market for goods, an appreciation of the value of the individual and the desirability of relieving him of tedious, repetitive, degrading work, and most of all, education and know how. There is a market here for more than nuclear reactors. The market is for the export and intelligent employment of the best and basic ingredients of our American way of life - freedom, initiative, ingenuity and faith in the individual. A washer and dryer are of no value if hunger stalks the land. There is an awakening of peoples throughout the world to the desire for independence and all that it can mean. We can help and should help such peoples with technological and educational programs - programs aimed at helping them to help themselves - not at telling them that if they will do as we do, their problems will be solved.

But the availability of power from the atom should enable backward peoples to progress as rapidly as their own development as a responsible community will permit. Thus the atom may well prove to be a catalyst of importance to all the world in its singular role of easily transportable power. It appears then that we may possess a unique and powerful instrument of foreign policy. Will we use it intelligently and to good purpose?

Perhaps the most honest approach to this subject is to admit that one can only conjecture about the real and lasting effects that atomic energy will have on our way of life. The crystal ball may help some - but of one thing we can be certain - the atom was split by men and the energy thus released will be controlled and directed by men - either for good or for evil. The knowledge that such great destructive power is available already has induced the exercise of patience and diplomacy of a high order in government circles. To

maintain the peace - even though it be an uneasy peace - will require that we recognize the increasing interdependence of men and nations economically, socially and politically. The preparation of men who will meet and discharge the responsibilities of this atomic age is the great challenge to our educational institution today. The evidence that this challenge will be met by your own great institution - Massachusetts Institute of Technology - is both impressive and reassuring.

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